Haaga-Helia
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Developing Technology Management in Digia

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Managing technologies is an important feat for a software and service company. Successful management of technologies can enable an organization to reach its strategic and business goals. Technologies itself are not necessarily business value-producing entities but are the key enablers for delivering services that can deliver business value.

This master's thesis focuses on the development activities related to updating the Technology Management process in Digia. There were two objectives for this thesis. The first objective was the development and continuous improvement of the Technology Management process in Digia Core Process Model (CPM) to better fit it to the need of Digia and to align it with Digia's strategy. The second objective was to evaluate the updated Technology Management process with Digia's business units and Human Resources (HR), identify next development activities, and create a plan for developing the Technology Management further.

There were multiple theoretical frameworks used to describe the different aspects of technology management. The foundation for the Technology Management process was Gregory's Technology Management process approach and there were additional frameworks for technology and service lifecycle management to achieve a holistic understanding of technology management in general.

The goal of this thesis was to reach the objectives and to initiate the Digia wide co-creation and co-development of technology management related activities. Co-creation was achieved through the involvement of all the relevant organization units within Digia regarding technology management related meetings and facilitate the gathering of data through prerequisites and follow-ups with the given organizational units.

The findings suggested that the Technology Management in Digia is in good shape. Due to the wide variety of heterogeneous organizational units in Digia, each of them having its own best practices to fit their technology stack and customer demand. Many development ideas could make the Technology Management process and its outputs support Digia to reach its strategic and business goals.

Digia is a growth company where the change is constant. As an author of this study, I am very satisfied with the results of this thesis have impacted me and my team can support the success of Digia as an IT company. Some parts of this thesis are confidential, and the published version introduces the outcomes and deliverables to the extent that does not reveal any confidential information.

Keywords
Technology, technology management, technology lifecycle management, quality management system.

Abbreviations

Chief Technology Officer	CTO
Core Process Model	CPM
Chief Technology Officer	CTO
Human Resources	HR
Proof of Concept	PoC
Public limited company	PLC
Quality Management System	QMS
Research and Development	R&D
Riskiest Assumption Tests	RAT
Service Portfolio Management	SPM
Strengths, weaknesses, opportunities, and threats	SWOT

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1 Introduction

Digia PLC (later Digia) is a software and service company operating in Finland. Digia has an ISO 9001:2015 certified Core Process Model (later CPM) which is Digia's Quality Management System (QMS) that guides its operations. The CPM describes Digia's basic processes and practices. The system ensures that, by following a certain process, tasks are performed correctly and consistently, while achieving the desired level of quality.

> *The adoption of a quality management system is a strategic decision for an organization that can help to improve its overall performance and provide a sound basis for sustainable development initiatives.*
>
> ISO 9001:2015(en) Quality management systems — Requirements (ISO, 2015).

Digia's quality policy supports the implementation of the company's strategy and provides a common foundation for high-quality work in product and service development, delivery projects, continuous services, and support functions that increases customer satisfaction (Digia Non-financial reporting, 2020).

The Technology Management process is one of the processes described in CPM and it is part of the Market-Driven Development core process group. Market-Driven Development group's goal is to ensure competitiveness in the market in which Digia performs its operations.

CPM is based on the continuous improvement and the continuous development of the CPM model that is coordinated by Digia Development & Processes organization. Anyone in Digia can contribute to the development of CPM through improvement ideas or projectized development activities. Continuous improvement of the Technology Management process is defined in the Technology Management Governance subprocess of the Technology Management which is later described under a topic 4.1.5 Technology Management Governance.

Technology Management process, as all processes in CPM, has a process owner. The Process Owner is held accountable for ensuring that a process is fit for its purpose. The Process Owner's responsibilities include sponsorship, design, change management, and continual improvement of the process and its metrics. At the time of writing this thesis I was acting as a process owner regarding the Technology Management process.

This thesis describes the development of the Technology Management process during the spring of 2020. Digia has released its new three-year strategy at the beginning of 2020 and the technology management development goal is to align the Technology Management process to Digia strategy.

In this thesis frameworks related to services, technologies, and technology management are reviewed to create an understanding of the reasoning for certain aspects in the Technology Management process in Digia.

1.1 Roles and responsibilities

This thesis was supported by having Digia's Chief Technology Officer (CTO) Mr. Juhana Juppo as a mentor. Mr. Juppo is also a member of the Digia's Management Team and the sponsor for the Technology Management process.

I work in Digia as a Director in the CTO Office delivery group. My responsibilities in Digia cover acting as a process owner of the Technology Management process in Digia, so this thesis is closely related to my daily work. CTO Office delivery group team has six members who are Enterprise, Business, and Solutions Architects. CTO Office team acts in a supporting role in commenting and reviewing the updates of the Technology Management process, participating in the meetings held with Digia business units and HR, and reviewing the plans for the next development activities regarding the Technology Management process.

1.2 Objectives

There were two main objectives of this thesis. The primary objective was to describe the development and continuous improvement of the Technology Management process in

CPM to better fit in with the needs of Digia and align it with Digia's strategy. The secondary objective was going through the updated Technology Management process with Digia's business units and HR, identifying the next development activities, and creating a plan on how to develop it further with technology management.

1.3 Research questions

The first objective was to describe the development and update process of the Technology Management process in CPM having two research questions:

RQ1: What are the key objectives that need to be updated in the Technology Management process in order to better fit Digia's new strategy?

RQ2: What needs to be considered and planned before updating a process in CPM?

The second objective was to find out and plan out the next development steps for the Technology Management process having also two research questions:

RQ3: What are Digia's prioritized list of development objectives for the Technology Management process?

RQ4: What is the plan to develop the Technology Management process to best fit the needs of Digia?

2 Digia PLC

Digia is a public limited company (PLC) whose headquarters are situated in Helsinki, Finland. Digia is listed on NASDAQ Helsinki (DIGIA). Digia's history dates back to a company called SysOpen Plc which was founded in 1990. From 2008 the company has been called Digia. In 2016 Digia performed de-merger to Qt Group Plc and Digia Plc and since then Digia company has grown to over 1200 employees (Digia History, 2020).

Currently Digia delivers software and services for its customers both domestically and internationally. Digia headquarters are situated in Helsinki Digia having also offices in Tampere, Jyväskylä, Turku, Oulu, Rauma, Vaasa, and Lahti and in Stockholm, Sweden. Digia's turnover in 2019 was EUR 131.8 million (Digia as a company, 2020).

2.1 Digia's strategy

Digia released its strategy for the years 2020-2022 at the beginning of 2020. Digia aims to be a visionary and reliable partner in a connected and data-driven world. Digia's driver in its business is the customer needs where businesses and organizations get networked and data utilization becomes increasingly important (Digia Strategy, 2020).

Exploiting and developing digital platforms and networks for operations are becoming more common and Digia worldview states that:

> *At Digia, we believe in a world in which value is created in ecosystems through smart data management.*

Digia's worldview (Digia CEO's review, 2020).

Digia's comprehensive offering of products and services provides its customers with intelligently designed functional entities. Digia continues to develop its expertise in delivering business-critical IT-services and ensuring the functionality and operability of those systems and services 24/7.

As the world is becoming more networked digital platforms enabling new business models, Digia's offering is enabling it to deliver holistic full-stack IT-services throughout IT-services lifecycles. Digia achieves this by offering its customers the following services: Service

design and business consulting, Digital services, Data and analytics, Integration and API, Business systems, and Monitoring and service management (Digia Services, 2020).

Digia's strategy defines the three key objectives: financial objectives, value for customers, and Digia as a company. Financial objectives include an annual net sales growth exceeding 10% and the target level of profitability improvement measured as an EBITA margin of 10 % by the end of 2022. Value for customers is delivered by being a visionary and reliable partner in a connected and data-driven world. In this development, Digia is a visionary and reliable partner valued by its customers, as well as a responsible learning community valued by its employees (Digia Strategy, 2020).

Digia's strategy 2020-2022 has five (5) publicly stated focus areas that are listed below.

1. Smart and responsible data utilization
2. Service Business
3. Productivity and scalability
4. Cloud Technologies
5. Valued Employer

These focus areas are then refined to more specific development activities internally.

2.2 Mergers and acquisitions

Digia's 2020-2022 strategy includes financial objectives in which the company seeks an annual net sales growth exceeding 10% including organic growth and acquisitions (Digia as a company, 2020). Successful mergers and acquisitions have been a big part of Digia's history and with the new strategy they will continue to be so.

Since Digia's demerger of SysOpen Digia Plc to QT Company and Digia there have been multiple mergers and acquisitions as seen in the below timeline.

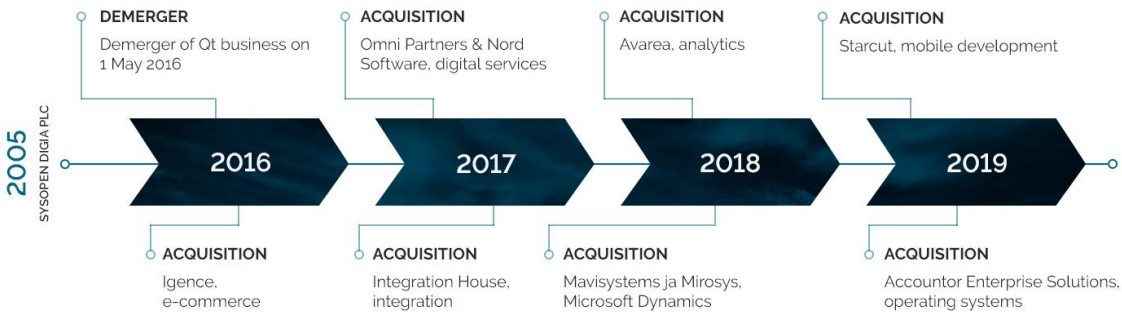

Figure 1. Mergers and acquisitions of Digia from 2016 to 2019.

Mergers and acquisitions play an important role in technology management activities in Digia as described in the topic 4.1.3 Technology Acquisition.

2.3 Technology management and strategy

A strategy is how business, government, or other organization do careful planning of their actions over a period of time, to improve their position and achieve what is wanted (Cambridge Dictionary, 2020). Focusing Digia's business on the focus areas mentioned in the previous chapter and seeking mergers and acquisitions will have also technological implications. Through technology management, Digia can seek opportunities provided by the technologies and evade or manage technology-related risks.

Digia does not have a technology strategy but the Technology Management process is tightly synchronized with the strategic process of Digia. Technology Management process enables Digia to correspond to short-term day-to-day management of technologies but also mid- to long-term management of technologies through individual technology's lifecycle and as a building block for the IT services.

Successful execution of the Technology Management process could benefit the business in many ways. Identifying and selecting the right technologies for the use in Digia could mitigate the risks involved throughout the developed services lifecycle. These risks for example could include the selection of technologies that have poor licensing models causing profit and revenue losses or selection of technologies that reach their end of life before the developed service reaching their production maturity.

Mergers and acquisitions have played and most likely will play a big role in Digia's path of growth and profitability. With a successful execution of a technology acquisition process, Digia can identify the key technological factors related for example the due diligence process initiated regarding acquisitions.

Successful exploitation of technologies having over 1200 employees on board can lead to major business benefits regarding productivity and scaled growth of expertise in any given technology used in Digia. In case all the exploited technologies will be identified, Digia can mitigate risks involved with operating deployed services and manage regarding service and technology lifecycles.

All the above mentioned makes the Technology Management process an important part of Digia's core business. This keeps me motivated as to the objective of this thesis, to provide a value for Digia executing the Technology Management process successfully.

3 Technology

Technology is a big part of modern everyday life in many aspects. Change of pace seems to be increasing immensely in our society and digitalization seems to be making an impact on that change. Digitalization has had different names in the past such as digitization or e-business (Kalakota and Robinson, 2003).

Digitalization is defined as the way of many domains of social life that are restructured around digital communication and media infrastructures (Brennen and Kreiss, 2016).

Technology solely is not a value-producing entity but rather an enabler for digitalization. I think that technology can act as an enabler for new and innovative digital services or products which help people, organizations, and governments to restructure their lives towards a more digitalized world. Business can harness technology and with it comes the possibility to create new business and operational models.

In business it is important to investigate possibilities of digitalization in the chosen industry and more widely outside of its market segment. Technologies can act also as a source of disruption which describes a process whereby a smaller company with fewer resources can successfully challenge established incumbent businesses (Christensen, Raynor and McDonald, 2015). Companies such as Netflix and Uber have been able to successfully challenge, disrupt and transform their corresponding industries of renting movies and providing transportation services, all of this being achieved through innovative usage of technologies to offer digital services for businesses and consumers.

Technology can hence bring opportunities through means of digitalization but also increase risks and threats through the disruption. Managing technology can enable organizations to manage the technologies that are relevant to a given market, industry, or business. I see that a successful managing of technologies could be a key success factor for an organization.

3.1 Technology management framework

Technology Management framework is designed for the management of technology-based on process thinking. Technology Management framework focuses on a holistic

lifecycle approach to managing technologies. The framework addresses different views of technology management including R&D, innovation, new product introduction, and competence development from a strategy and a resource perspective from economics (Gregory, 1995).

Gregory's Technology Management framework and its process approach had been initially selected to address the needs of Digia technology management a few years ago. As the initial implementation and tailoring of the Gregory's Technology Management framework were done by individuals who no longer working in Digia, it was chosen to be researched further and hence tailor the framework to fit the current Digia needs for technology management.

Gregory describes the framework as a comprehensive view of managing technology through the following areas: competence and capability, research and development (later R&D) management, innovation, organizational learning, and new product introduction (Gregory, 1995). Gregory describes 15 important issues for each of these areas from which I have selected the eight (8) key issues that are the most important from my perspective.

The reasoning regarding issue priority was done by evaluating all key issues with their related impact on cost, maturity, the implementation impact, and the business impact. I summarized and prioritized the key issues founding the following being the most important ones based on this analysis:

1. understanding opportunities to leverage technology
2. the importance of protecting key technology skills
3. team structures and dynamics
4. early visibility and assessment of technologies
5. product management
6. wide involvement of company staff
7. systematic capture of knowledge
8. ability to reconfigure to tackle new tasks

The above mentioned eight key issues to tackle are already covering a wide range of different expertise needed in an organization from such as HR, recruiting, development, and operations. This means that in a company such as Digia there is a need to somehow centrally manage our technologies to achieve business excellence with more opportunities and fewer risks.

Technology Management framework includes five process phases: identification, selection, acquisition, exploitation, and protection as seen in the figure below (Gregory, 1995).

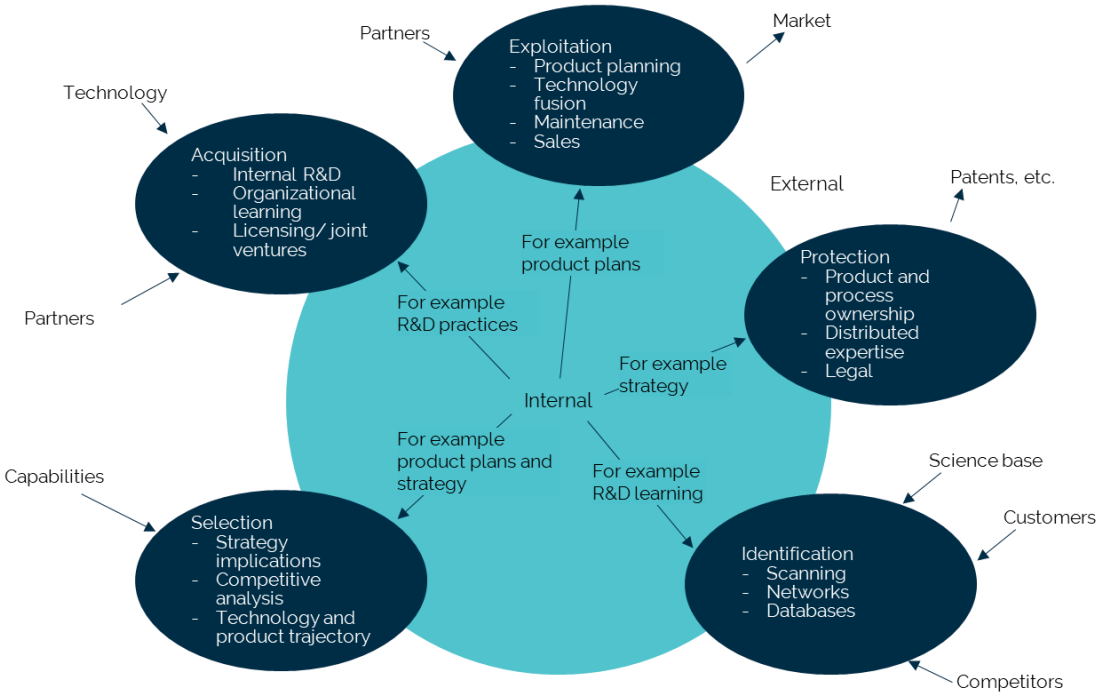

Figure 2. Key issues within the Technology Management process framework. (Gregory, 1995).

Identification

Identification involves developing an awareness of all the technologies which are, or may in the future be, important to business (Gregory, 1995). Technologies can be important to business in many forms and as mentioned in a previous topic, technologies presenting both opportunities and threats. Technologies can be identified from internal or external sources. Internal sources usually come out from the R&D process or in Digia context from the individual internal organizational units developing and delivering their respective IT

services each with their tech stack. External sources include market trends, competitor landscape, customer demands, hype cycles, and science-based research.

To grasp the actual impact of individual technology identifying needs to be done holistically. Insufficient analysis of technologies impacting the organization can lead to disruption.

In Digia individual organization units follow up their field of expertise to identify relevant technologies. There have been active discussions on should there be a central identification process of technology trends. As of now the feasibility of following all the technology trends is seen best to be handled by individual organizational units and then facilitating the follow-up meetings to summarize and aggregate the lessons learned in Digia corporate level.

Selection

Selection involves the choice of technologies that should be supported and promoted within the organization (Gregory, 1995). The selection of technologies can act as making a difference for any organization. Selecting the technologies that have a poor strategic or business fit can lead to financial implications. Selecting the right technologies, which have a good strategic and business fit can lead to the possibility to achieve strategic and business goals.

The impact of selecting the right technologies in a larger organization is even more important as it can lead to more scaled efficiency and better business results or on the other hand wreck business models since fewer people developing with the wrong technologies the technology can be more easily replaced. In case many people are developing with the wrong technology the need for restructuring the already developed system with a better technology may and most likely will cost more. The actual impact of technology choices can be seen in the exploitation activity.

In Digia almost all the technology choices are done by an individual organizational unit. Digia's CTO Office team aims to help analyze and improve each organization unit's technology choices, gathering information about the selected technologies, and making sure

that they adhere to the strategic and business goals. The goal for successful technology choices should not be making all the decisions in CTO Office or other central location in Digia but enable the scale and productivity benefits gained from governing the technologies in individual Digia organization units. This will mitigate the risks of doing duplicate work in many organizational units. Technologies already selected in some organization units can be more easily exploited elsewhere with a better understanding of how to implement the given technology.

Acquisition

The acquisition activity is concerned with the decisions about the appropriate means of acquiring selected technologies and embedding them effectively within the organization (Gregory, 1995). Acquisitions can be made internally as results from R&D or organizational learning. An acquisition could also happen externally triggered by technology partners, technology owners, or technology developers, as a form of licensing, joint ventures, or acquiring an entire company.

The acquisition activity is relevant in Digia as there has been a total of 9 companies merged to Digia in the past four years as described under the topic 2.2 Mergers and acquisitions.

Exploitation

Exploitation is concerned with the systematic conversion of technologies into marketable products, or the realization of their value through sale or joint venture (Gregory, 1995). In Digia there are currently over 176 identified technologies, but even more of the technologies are in use, as this is only a summarized and aggregated data set as described more closely in the topic 4.5 Digia Tech Radar. Exploitation in Digia means using these selected technologies most efficiently and productively.

The usual way of exploiting technologies in Digia occurs when a software development team (later team) develops an IT service or services. The team consists usually of multidisciplinary cross-functional individuals with expertise in various parts of IT services. The team works with a technology stack specifically designed to be a fit for the purpose of the

IT services vision and goal. Selected technologies must be enablers for the team to develop the functionalities implementing user stories or other requirements set for the IT service in the attained scope of time, resources, and quality. With an exploitation activity Digia aims to make sure that the teams have the necessary capabilities and knowledge to exploit the technologies to their maximum extent hence creating a maximum amount of value to our customers, their IT services end-users, and Digia.

Exploitation activity is closely intertwined to centralize knowledge development with Digia HR services and Digia Tribes which are described more closely under the later heading 4.4 Stakeholders. This way Digia can increase the scalability possibilities of all our experts. Technology Exploitation activity in Digia is more closely described in the topic 4 Technology Management in Digia.

Protection

Protection is concerned with the preservation of the knowledge and expertise that are embedded in products and manufacturing systems (Gregory, 1995). Protection is intertwined with all other technology management activities and includes the lifecycle view on individual technologies. Protection can be achieved through continuous knowledge development, employee retention, following the technology lifecycles, and legal routes such as licensing or patenting. In this way the risks related to technologies can be managed and possible opportunities can be capitalized on.

In Digia the protection means setting up a governance model within Digia's Technology Management process making it possible to have active discussions with individual organizational units and corporate level services and hence manage negative and positive risks related to technologies.

3.2 Technology lifecycle

technologies are having their lifecycles. Some technologies lifecycle is affected by other technologies success or demise. Technologies have also different kinds of risks involved within them regarding cybersecurity and other vulnerabilities until the end of life phase which may happen sooner than anticipated.

Understanding the technology lifecycle and different phases of the lifecycle helps Digia to make better technology-related decisions and manage risks and opportunities throughout the technology's lifecycle.

Managing technology lifecycles in Digia is part of Technology Management processes technology exploitation and Technology Management Governance subprocesses which are described more closely in the topic 4 Technology Management in Digia. The following technology lifecycle definitions Hype Cycle and Technology adoption lifecycle act as a foundation of the Technology Management process in Digia.

Hype Cycle

Hype Cycles are a useful starting point for discussion and prioritization of technology candidates because their relative positioning and their "years to mainstream adoption" ratings contain implicit assumptions that decision-makers need to lay on the table (Gartner, 2010). Gartner relies heavily on the Hype Cycle while visualizing their analysis results of evaluated market trends in general or with a narrower scope of an individual segment such as marketing or enterprise-size such as a midsize enterprise.

Hype cycle describes the typical progression of technology from the first innovative implementation of the technology to the peak hype phase with inflated expectations to a more realistic and mature later phases of technology adaption where disillusionment, enlightenment, and productivity are achieved as seen in the figure below.

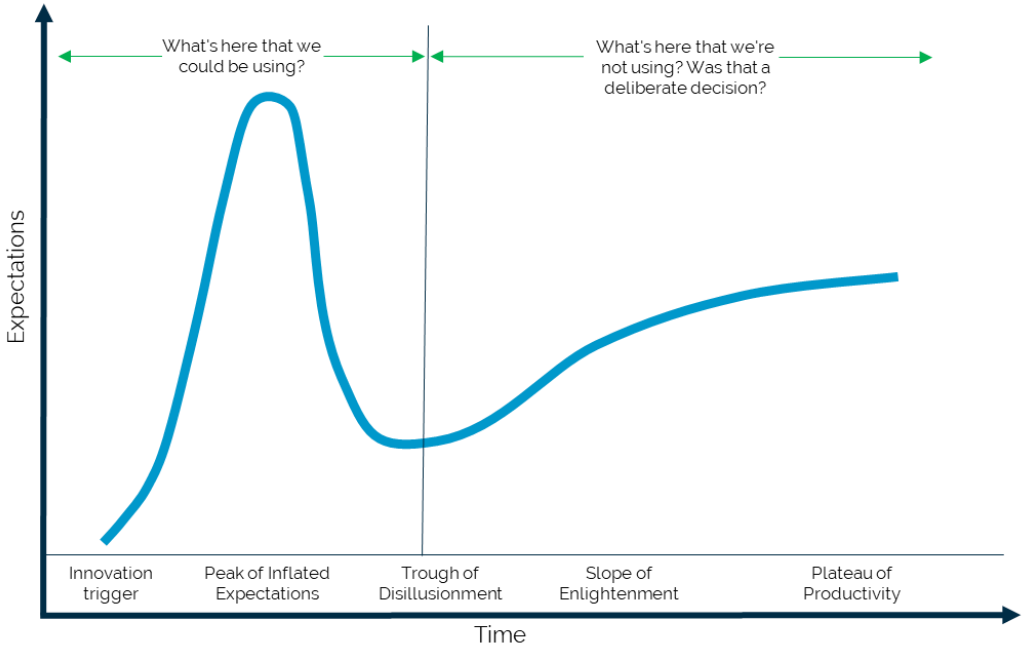

Figure 3. Two key questions and an overview of the Gartner Hype Cycle technology progression (adapted from Gartner, 2010).

Hype cycle can be used to answer the two key questions about individual technology and make a more profound selection and investment on technologies. Technologies identified as being in the early phases should be asked a question what the technologies in the early phases are that an organization could be using. Technologies identified as being in the mature and later phases of technology lifecycle questions should be asked of what is there that we're not using. Also, it is important to reflect the technologies, not in use, and to ponder were those choices deliberate. Asking these questions could help an organization to develop decision-making involving technologies.

Technology adaption lifecycle

Technologies are adapted in different lifecycle phases. Adapting or selecting technologies as mentioned in the Gregory Technology Management framework (Gregory, 1995) can make the selector an innovator, early adaptor, early majority, late majority, or laggard. Between the early adaptors and early majority there lies a chasm that divides companies between early-stage visionaries and later pragmatists (Moore, 2014) as visualized in the below figure.

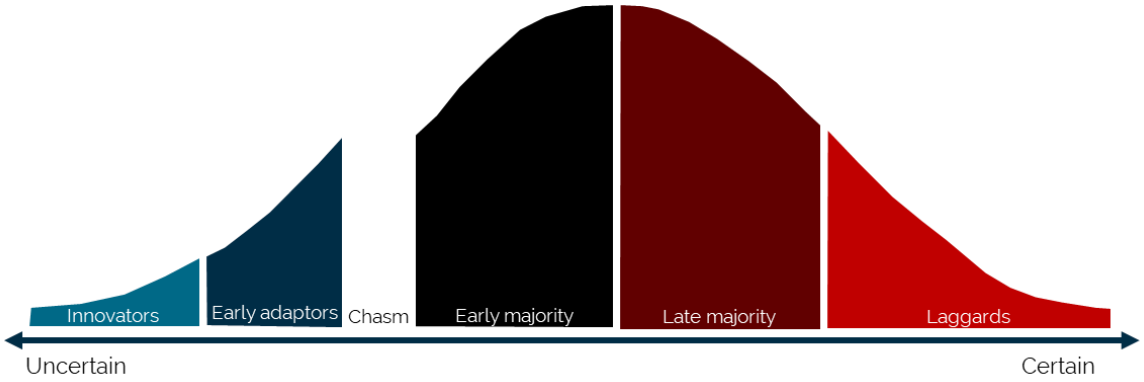

Figure 4. Technology adaption lifecycle and the chasm (adapted from Moore, 2014).

Being called pioneer or bleeding edge innovator has its risks as the uncertainty for the technology selection is higher. At these early stages it is harder to evaluate and select the right technologies that would produce and enable the organization to achieve and even exceed its strategic and business goals. In the later phase's certainty increases and it is clearer on what technologies should one choose and how to efficiently exploit the technologies but at the same time might not produce any competitive advantages in the market one operates in as adapted technology is already widely exploited in the market.

The technology adaption lifecycle can also be viewed by combining it into the same timeline as the hype cycle as depicted in the figure below.

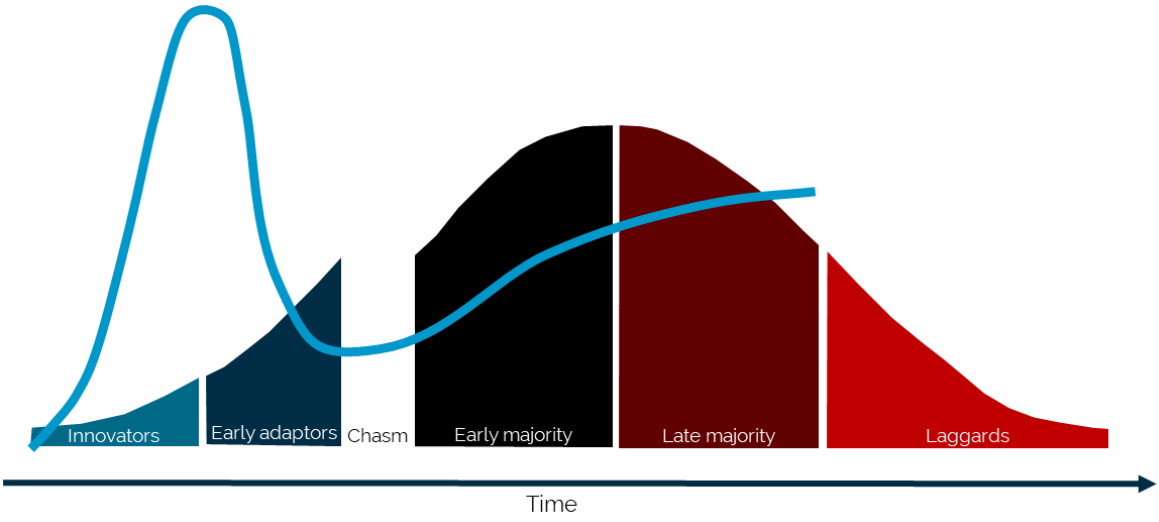

Figure 5. Hype cycle and technology adaption lifecycle combined view (adapted from Gartner, 2010 and Moore, 2014).

As described in Figure 3. Two key questions and an overview of the Gartner Hype Cycle technology progression (adapted from Gartner, 2010)., the hype cycle has two important questions to answer and they are separated by the chasm in the technology adaption lifecycle which corresponds to the hype cycles trough of disillusionment phase. Before the chasm organizations should be asking the questions on how to identify technologies that could be selected, acquired, and then eventually exploited in an organization.

After the chasm organizations should consider the same questions as before the chasm. Technologies adapted after the chasm can be useful and a difference-maker to an organization if exploited efficiently. But as other organizations might have adapted the technology earlier, they might have an edge on the business perspective of utilizing the technology in the market. Organizations should try to learn from past missed our opportunities related to technology choices to maintain a competitive edge in their market.

End of life phase

Hype cycle and technology adaption lifecycle both focus on the earlier stages of the lifecycle and do not take into consideration what to do with obsolete, declining, or dying technologies which include technologies that are in the later stages of their perspective lifecycle. Technology adaption lifecycle does have the laggard's phase which could mean that the laggard selector or adaptor of technology uses technologies that are at the end of life

phase but the technology adaption lifecycle does not describe more closely on what to do with technologies that reach their end of life phase.

Reasons leading to the end of life as a technology can be numerous. There might be a new technology which is more efficient or productive to develop with, a technical debt of an old technology might have increased to an amount that new features are not feasible to create anymore, the owner of the technology stops developing the technology due to bankruptcy or the business model ceases to exist and costs going into the development or support for the technology is no longer feasible.

The last stages of the technology lifecycle can be also called retirement, disposal, or dog phase. Retirement and disposal phases are related to activities where the technology is replaced with some newer technology or retired without a replacement as their productivity and ability to produce value has declined to a phase where there is no longer a business case to develop and support the technology or the service it supports.

Dog phase describes technologies that have low share and low growth opportunities (Henderson, 1968). These technologies in the dog phase should be retired or disposed of. In technology management as in any lifecycle management aspect the dog phase is crucial to understand to make an enlightened decision to retire a technology and stop pouring money on something that does not produce any value.

3.3 Service lifecycle management

With different kinds of technological solutions, it is possible to create services. Service is about enabling value co-creation by facilitating outcomes that customers want to achieve, without the customer having to manage specific costs and risks (AXELOS Best Practice Publications, 2020). IT service is a service based on the use of information technology (AXELOS Best Practice Publications, 2020). As technologies have a lifecycle which needs to be managed as described in the previous topics the services have their respective lifecycle which needs to be managed.

Managing the services lifecycle is an important activity in Digia providing its customers IT services and is often responsible for the entire lifecycle of the IT service.

There are many frameworks that define the service lifecycle: Business Technology Standard (Business Technology Standard, 2020), ITIL v3 (Axelos, 2013), and The Service Lifecycle (Kohlborn, Korthaus, and Rosemann, 2009) of which are being described below.

Business Technology Standard

The Business Technology Standard is an open-source management framework to manage information technologies and activities related to IT services (Business Technology Standard, 2020). Service lifecycle phases are described under the Service Portfolio as: in funnel, in pipeline, in production, retired, archived or not known as described in the figure below (Business Technology Standard: Service Portfolio, 2020).

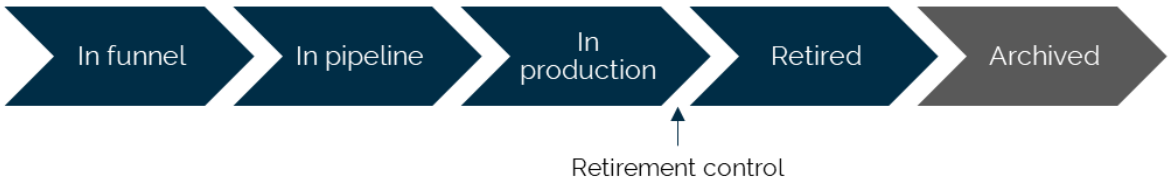

Figure 6. Service lifecycle phases (Business Technology Standard: Service Portfolio, 2020).

Technology choices are typically done in the in-funnel and in-pipeline when the IT services are being designed and developed. During the in-production phase technologies might be replaced and new ones selected.

The retired phase starts with the activity of retirement control, but the standard does not describe more closely the activity. During the retirement phase the technologies in use are usually retired with the IT service itself. Retirement is followed up by an optional Archived service lifecycle phase in case the environment has regulations that demand the archiving of the service for regulatory traceability purposes.

ITIL

ITIL v3 is the older version of the current AXELOS ITIL 4 version. The ITIL v3 described closely the ITIL Service Lifecycle and its purposes helping to understand the value of the ITIL service lifecycle, how the processes integrate throughout the lifecycle and explain the objectives, scope, and business value for each phase in the lifecycle (AXELOS, 2013). The

ITIL Service Lifecycle consisted of the following phases: Service Strategy, Service Design, Service Transition, Service Operation, and Continual Service Improvement. Based on ITIL v3 individual services and their lifecycles are managed within the Service Catalogue as part of the Service Strategy's Service Portfolio Management (SPM). Within the Service Catalogue some services eventually are phased out or retired.

As ITIL 4 is the newest version the ITIL v3 still has relevance in the market. ITIL 4 expands on previous ITIL versions and it provides an end-to-end IT/digital operating model for the delivery and operation of tech-enabled products and services enabling IT teams to continue playing a crucial role in wider business strategy (AXELOS: ITIL Update, 2020). The ITIL v3 has its strengths in the ITIL service lifecycle focus and detailed descriptions of activities, processes, and roles involved in the lifecycle. ITIL v3 still has relevance today as a good knowledge base to search on how to execute certain processes within the service lifecycle.

The Service Lifecycle

The Service Lifecycle describes the lifecycle phases of service as seen in the figure below.

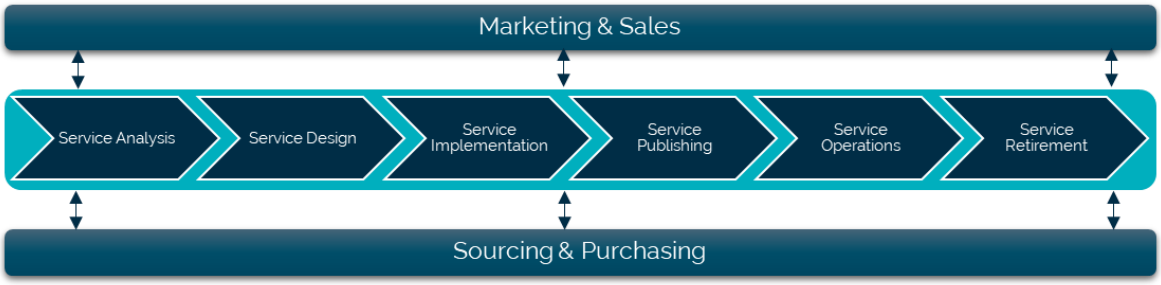

Figure 7. The Service Lifecycle (Kohlborn, Korthaus and Rosemann, 2009).

The Service Lifecycle compromises of six (6) phases: Service Analysis, Service Design, Service Implementation, Service Publishing, Service Operations, and Service Retirement. All phases are adjacent to each other and the duration of each stage depends on the nature of the service. Bigger the service that needs to be analysed, designed, and implemented the longer it takes to reach the first potential customers of the service.

Depending on the maturity of the market where the service is to be consumed or sold as described previously in the technology adaption lifecycle it should be considered that reaching the potential market faster than the possible competition could lead to the major business benefits. Selecting the right technologies to develop a new service can shorten the time-to-market immensely.

The Service Lifecycle has a governance model. Governance means how an organization is directed and controlled and is an Executive Board level matter. Governance ensures and protects the stakeholder's needs, conditions, and options which are evaluated to determine the enterprise objectives, ensuring that the direction is set through prioritization and decision making and ensuring that performance and compliance are monitored against objectives (ISACA, 2020). Service governance means managing the service lifecycle throughout the service lifecycle phases as described in the figure below.

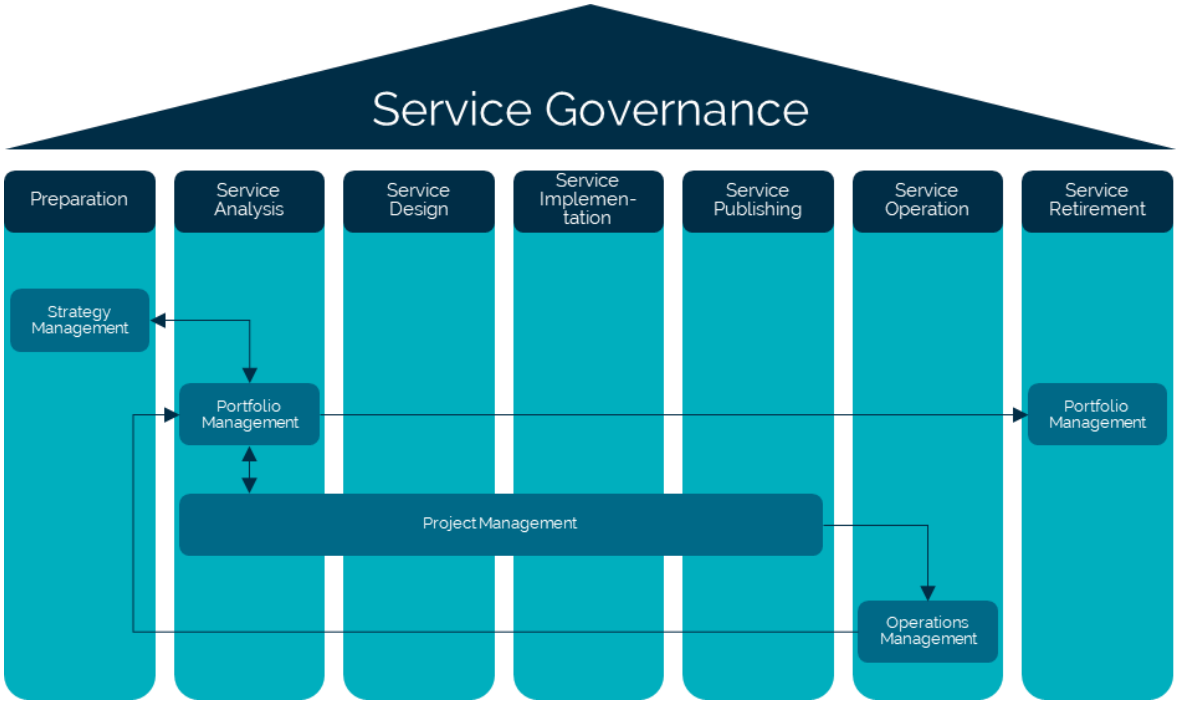

Figure 8. Integration of service lifecycle and management layers (level 1) (Kohlborn, Korthaus, and Rosemann, 2009).

The service governance perspective introduces a new phase to the lifecycle called preparation. In the above figure the phases portrayed include the respective management processes. Within the preparation phase there is the strategy management process that links

back to the corporate strategy and in a more technically focused service organization back to the IT strategy (Kohlborn, Korthaus, and Rosemann, 2009). In the strategy management certain technology framework activities could be considered to identify possible technologies that could help the organization to realize its strategy.

After the preparation phase the service lifecycle goes to the service analysis phase where portfolio management manages requirements of a large set of services per individual portfolio. Portfolio management also has a feedback loop leading back at strategy management as changes to the portfolio management may lead to changes in the organization strategy. In the portfolio management phase, it is relevant to identify and possibly pre-select the technologies which can be used to realize the requirements set out in the given portfolio. Also, portfolio management is responsible for the service retirement phase, as a higher level of decision making is needed to evaluate the viability of a given service and its relationship to the rest of the portfolio. Decisions of service retirement also include the retirement of technologies which have been used to build the service.

After these phases' portfolio management is split into project management where individual services can be analyzed, designed, implemented, and eventually published. As a result of a project management phase the published service can be handed over to the service management activities. Within the project management there are many technology management activities identification, selection, exploitation, and protection as described in the topic 3.1 Technology management framework.

Operations management is responsible for the value delivery of the services. Operations management aims to achieve effectiveness and efficiency in the delivery and support of services to make sure that the value for the customer and the service provider are delivered on time and quality. Within the operations management the technology management activities mostly include the exploitation and protection of the technologies. Operations management has a feedback loop back to the portfolio management to implement potential changes within the portfolio to improve the value delivery of the services.

4 Technology Management in Digia

The goal of the technology management in Digia is to identify, select, acquire, exploit, and govern technologies which enable Digia to increase our productivity and efficiency in delivering value-creating IT-services.

Digia creates a solid backbone of knowledge and expertise regarding the selected technologies and exploiting the selected technologies to achieve its strategic and business goals. Digia aims to gain a competitive edge by creating a support structure around the selected technologies spreading and developing the technical knowledge within Digia. By these supporting structures Digia enables decreasing the costs and risks related to the selection and exploitation of technologies and decreasing the learning gap of experts moving within Digia to other organizational units.

By focusing on key technologies, Digia can deepen the expertise on selected technologies also improving Digia's personnel satisfaction as technology experts get to work in an environment where they feel supported and being able to work with the latest technologies.

Adapting new technologies is an important trait to correspond to changing and increasing customer demand. At the same time selected technologies must adhere to quality and service level requirements to produce and operate IT services which should be working in the entire IT service portfolio without quality concerns.

Customer demands vary from fast-paced exploratory of new digital services to a slower pace long-term planning and development of core IT services such as enterprise resource planning (ERP) services. Digia is choosing its key technologies based on both aspects which correspond to developing bimodal capability (Gartner, 2020) within Digia and its customers.

Digia has a Technology Management process that enables the creation of value-adding IT services, quality operations of those services throughout the IT service portfolio developing Digia's capability to compete in the market.

4.1 Technology Management process

Digia Technology Management process is mainly tailored and adapted from the Gregory's Technology Management process approach as described in the topic 3.1 Technology management framework. The technology lifecycle and service lifecycle management frameworks described in the topic's 3.2 Technology lifecycle and 3.3 Service lifecycle management are tailored and adapted to within the Technology Management process and its subprocesses.

The Technology Management process is divided into five subprocesses describing the technology lifecycle of technology in Digia. Subprocesses are:

1. Technology Identification, to identify technologies that are or may in the future be important to the business.
2. Technology Selection, to select technologies that should be supported and promoted within the organization.
3. Technology Acquisition, to acquire selected technologies through mergers and acquisitions and embedding them effectively into the organization.
4. Technology Exploitation, to systematically convert technologies into marketable products and services to be used efficiently.
5. Technology Management Governance, to govern the Technology Management execution which is closely related to Gregory's Technology Management frameworks Protection process phase as described earlier in this thesis.

Each subprocess is an independent process or can be part of a longer process. Entry into this process can happen from any point, not just from Technology Identification.

4.1.1 Technology Identification

Technology Identification subprocess is used to identify technologies that are either new or not yet in Digia Tech Radar. Digia Tech Radar is a description of technologies used in Digia and is described more closely in the 4.5 Digia Tech Radar. The purpose of this process is to identify technologies that might be relevant to Digia's business needs. Usually identified technologies will move on from Technology Identification to Technology Selection subprocess.

The Technology Identification process involves the following phases:

1. Gathering, to gather information from various internal and external sources on any possible technology that might be used in Digia and therefore should be screened.

2. Screening, to screen and validate gathered information on given technologies to make sure that sufficient data is ready for further analysis.

3. Analyzing, analyzing the technologies and as an output report the findings for technology selection.

After Technology Identification the technologies that are analyzed and put to the Technology Selection subprocess for further analysis.

4.1.2 Technology Selection

Technology Selection subprocess is triggered when it receives input from the Technology Identification subprocess. Purpose of the Technology Selection subprocess is to select technologies that should be supported and promoted within the organization.

The selection of technology is done by holistically evaluating the technology. Selection criteria involve evaluating the following criteria: effectiveness, internal capabilities, market capabilities, global trend, lifecycle, learning curve, customer demand, attractiveness to experts, expected revenue, licensing, fit to Digia's strategic goals, fit to Digia's business goals, and Digia wide exploitation possibilities. During the evaluation insight, consultation and recommendations are gathered from Digia Tribes, Digia business units, other external stakeholders or customers depending on the given technology the process being facilitated by CTO Office.

Technology Selection subprocess has two possible outcomes: de-selection or selection of technology. Selection means technology is to be exploited in Digia and de-selection means technology is not chosen for further exploitation. All decisions are documented for later as some technologies might be evaluated for selection in the future if for example business environment changes and evaluation criteria need to be re-evaluated.

In case the technology is selected to be used in Digia the Digia Tech Radar is updated accordingly and possible exploitation plans are done to efficiently introduce the new technology to Digia. Selected technologies will move on from Technology Selection to Technology Exploitation subprocess.

4.1.3 Technology Acquisition

Technology Acquisition subprocess's purpose is to acquire selected technologies through mergers and acquisitions and embedding them effectively into the organization. The Technology Acquisition activities are concerned with decisions about the appropriate means of acquiring selected technologies and embedding them effectively within the organization. Technology Acquisition subprocess is closely linked to the Digia CPM Merger & Acquisition Process.

Technology Acquisition subprocess provides help to evaluate the M&A funnel targets and later the M&A targets technological capabilities. After a decision to merge and integrate an acquisition Technology Acquisition subprocess creates a technology integration plan to help the successful and efficient merger of the acquired organization's technological stack and know-how to Digia. The integrated technologies are moved to the Technology Exploitation subprocess.

4.1.4 Technology Exploitation

Purpose of the Technology Exploitation subprocess is to systematically convert technologies into marketable products and services to be used efficiently by Digia and support in end of life retirement matters.

Technology Exploitation activities include screening and retirement of technologies. Screening activities relate to new or existing technologies in Digia and evaluation of their exploitation in new or existing projects or services.

Retirement activities are related to evaluating the retirement need of existing technology and creation of a retirement plan where the technology is replaced with some newer technology, or being retired without a replacement as their productivity and ability to

produce value is being declined to the stage when there is no longer a business case to develop and support the technology or the service it supports.

Technologies reaching their respective end of life in Digia end the Technology Management process. Technologies that are screened for being used in Digia development or operating of IT services are moved to other CPM processes for further business development.

4.1.5 Technology Management Governance

Technology Management Governance subprocess purpose is to describe the management activities for governing the Technology Management process in general.

Technology Management Governance management activities are described in an annual clock with meetings related to aligning the Technology Management process to Digia strategy, identifying technology-related changes in Digia, identifying recruitment or knowledge transfer needs, and identifying positive and negative risks related to the technologies in-use or not yet in-use in Digia.

Technology Management Governance enables also the continuous improvement of the processes as we can discuss and get feedback from Digia's internal stakeholders about the strategic and business fit of the Technology Management process to Digia. Based on the annual clock, the biannual meetings create a continuous improvement cycle of plan, do, study, act as described in the figure below.

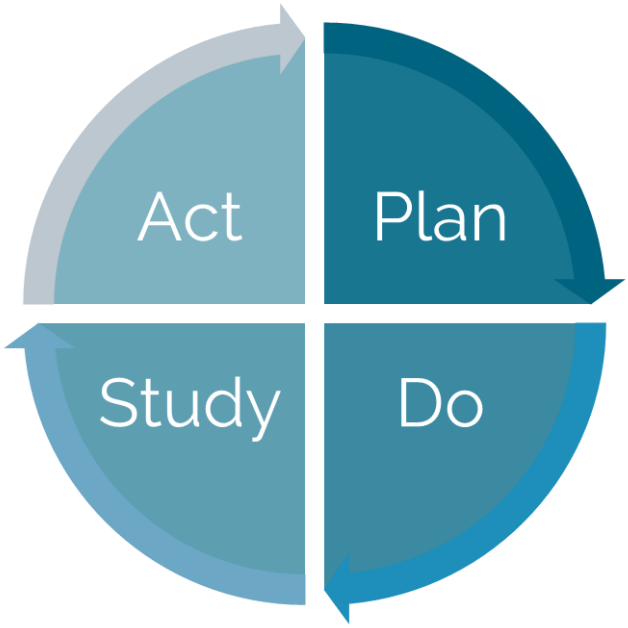

Figure 9. Plan, Do, Study, Act (Deming, 2020).

Technology Management Governance process is closely related to Technology Management Frameworks process phase Protection (Gregory, 1995) and it has similar characteristics such as business continuity and the preservation of the knowledge and expertise that are embedded in Digia.

4.2 Technology management guiding principles

Technology management in Digia has guiding principles that direct ways of working for better utilizing and exploiting the technologies and expertise to achieve a competitive edge. Technology management guiding principles are based on Digia's strategic and business goals because the solutions we deliver are increasingly providing business value through services and products and not just through technologies.

Technology managements guiding principles are described below and they are created based on Digia's strategic focus areas.

1. We can work together to ensure the quality of the data in all our work whether it is related to a customer IT-service or our internal IT-systems. In this way the whole System of Systems works together seamlessly and value from the data can be exploited exponentially in a holistic manner.

2. Technologies are just technologies and do not produce any real value on their own. We can learn to better harness the technologies we exploit and instead of selling just the technologies we can sell value creation through products and services which helps us to better position ourselves in the competing market.

3. To achieve productivity and scalability gains we can work together to spread the knowledge and expertise we have on different technologies. By helping each other out everybody does not have to figure out and learn things from scratch and re-usability gains can be achieved.

4. Cloud is here for good and we can learn to better take advantage of it. On-premise Data Centers are not going to extinct, but a cloud mindset also helps us to better exploit Data Center capabilities preparing us for a path of possible cloud migration.

5. We want our technology stack to be a source of enlightenment, excitement, and enthusiasm. We can work with technologies that our existing and not yet existing experts believe in and create digitalization that makes a difference.

These technology management guidelines are embedded in Digia's Technology Management process which is described more closely in the topic 4 Technology Management in Digia.

4.3 Managing technology-related risks and opportunities

Risks related to Technology Management Process and all its subprocesses are managed by the process owner risks being governed as described in Digia CPM Corporate Risk Management Process.

Risks and opportunities are identified and analyzed in Technology Management meetings biannually as described in Technology Management Governance or by Tech Radar update proposal process which is initiated by submitting the suggested update through Digia Tech Radar "Digia Tech Radar update proposal" form.

Treatment methods and treatment plans are documented regarding each risk, which shall also include a link to the started actions. All identified and analyzed risks are automatically passed to the Corporate Risk Management process.

Identified operative level development opportunities may be analyzed and implemented by any individual business unit. Digia wide opportunities for development, which may e.g. lead to new practices, are managed through Innovation Management's Idea Process. Started actions are managed as other process improvement initiatives.

Customer and sales-related opportunities are passed to the Account Management process, which takes care of lead validation, qualification moving them towards the opportunity pipeline.

4.4 Stakeholders

Key stakeholders for the Technology Management process include Chief Technology Officer (CTO), CTO Office, Human Resources (HR), individual organization units, and tribes.

CTO is consulted and informed upon any major technological findings from the Technology Management process. CTO Office supports the governance and development of the Technology Management process and accountable person within the CTO Office acts as a process owner of the Technology Management process. HR supports the coordination of Digia level knowledge and competence development related to technologies and HR participates in the Technology Management Governance subprocess meetings.

Tribes

Digia introduced tribes as internal technology communities in 2017. Tribes are open communities with regular meetings, active discussions on Digia collaboration platforms, organized by tribe leaders and places that gather wide involvement in Digia. If a tribe chooses to need a tribe leader the role of the tribe leader is to be a supportive, facilitative, enabler, and servant leader for the tribe.

Currently Digia has 16 active tribes. From those 16 active tribes there eleven (11) technically oriented tribes and which some have multiple subtribes for more in-depth technical

focus. The rest 5 tribes are related to culture, leadership, and methodologies which have less insight on technology matters. The 16 active technology tribes are sharing insight and lessons learned on the technologies used in their perspective interest area.

Technology Management's Technology Selection subprocess involves tribes in the selection process to have the necessary technical experts to evaluate the feasibility of the technology selection at hand.

4.5 Digia Tech Radar

Digia Tech Radar is one of the key results of the Technology Management process. The Digia Tech Radar can be found publicly online with aggregated data sets and as a figure below.

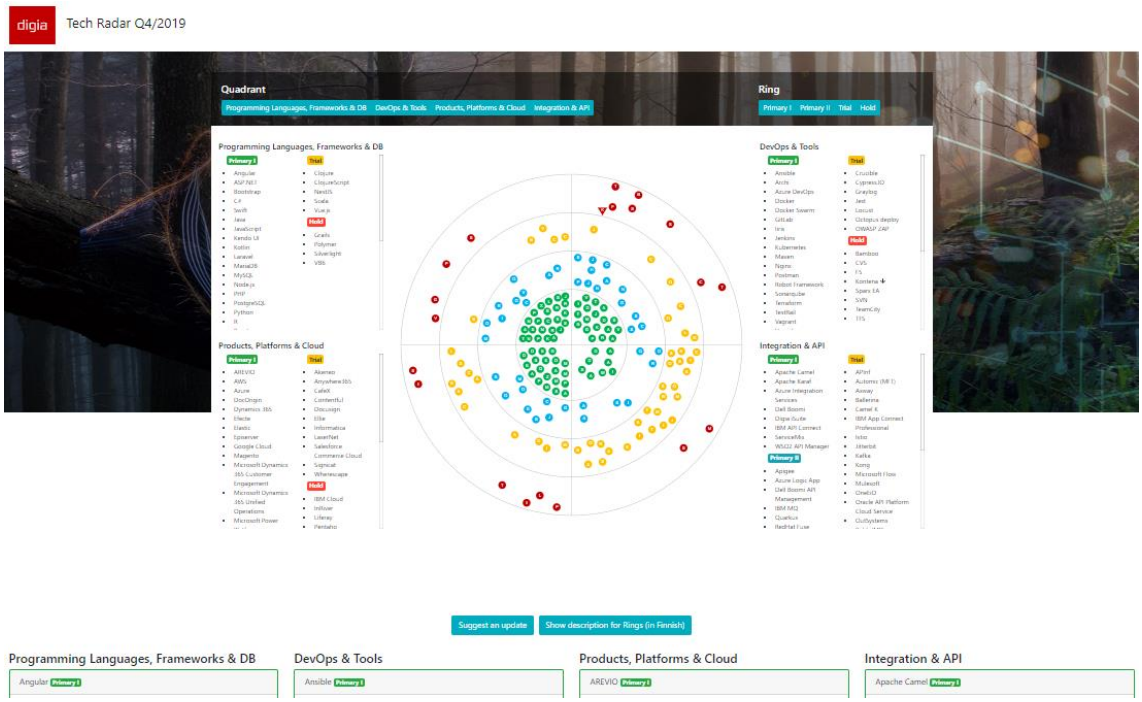

Figure 10. Digia Tech Radar screenshot from https://techradar.digia.online/ (Digia Tech Radar, 2020).

Digia Tech Radar is a representation of Digia technology stack. Digia Tech Radar has a wide range of technologies. As of the writing of this thesis there were 176 identified technologies in the aggregated data set published in Digia Tech Radar. Since the data set is being aggregated, it contains an estimated approximately over 300 individual technologies

being used in Digia's day-to-day operations. In some sense, this can be considered a high amount of technologies, but it should be considered that in Amazon Web Services (AWS) alone there are over 175 fully-featured services from data centers globally (Amazon, 2020) which are only aggregated as only AWS in the Digia Tech Radar.

Digia Tech Radar is used to communicate the different technologies used in Digia for internal and external stakeholders. Digia Tech Radar compromises of four different quadrants and four rings.

4.5.1 Digia Tech Radar Quadrants

Quadrants are used to categorize the technologies to help manage the technological stack. All quadrants have their naming done in a way that would help to guide the appropriate quadrant selection for each technology. Quadrants are:

- Programming Languages, Frameworks, and DB
- DevOps & Tools
- Products, Platforms, and Cloud
- Integration & API

4.5.2 Digia Tech Radar Rings

There are four (4) rings in Digia Tech Radar which is used to describe the lifecycle state and usage in Digia for all technologies. Any changes to the ring for an individual technology can result from for example the increase or decrease of technologies market demand. Changes to the technologies ring are described in the Digia Tech Radar visually with a graphical notation of a bullet meaning that the trend has not changed, or by an upward or downward triangle indicating the upward motion to closer to the center rings or downward motion to outer rings.

The following descriptions of each ring act as a guiding description for evaluating the right ring for individual technology.

Ring 1 Primary I

These are the technologies, that Digia uses actively and are actively used in solution proposals. These technologies are well tested and proven to work in Digia. Digia actively develops skills regarding expertise and recruitments in these technologies.

Ring 2 Primary II

These are the technologies for which Digia will upkeep the knowledge. Digia does not offer them actively but will deliver with them based on customer needs. The technologies can be chosen if the primary I recommended technology does not fit the need.

Ring 3 Trial

These are the technologies, for which Digia is still indecisive. They can be new potential ones or might be reaching the end of their lifecycle. They are on Digia radar but not recommended to be adopted in active development.

Ring 4 Hold

These are the technologies that Digia follows but are not yet in wide use, or that have been used earlier and deemed not to be used any further.

5 Methodology, methods, and stakeholders of this study

5.1 Action research

The thesis research strategy is based on Kemmis and McTaggart's action research spiral where each spiral has three steps: plan, act and observe and reflect as described in the below figure.

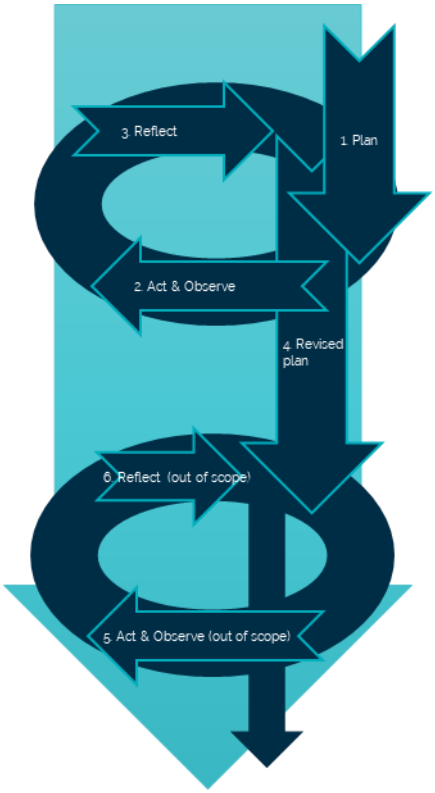

Figure 11. Action research spiral with this thesis out of scope defined (Kemmis and McTaggart, 2010).

The first spirals plan, act and observe steps are focusing on the first objective of the thesis which is to update the Technology Management process in CPM. This means describing the plan of the update process and describing the activities related to updating the CPM (act & observe).

Reflecting on how the updates are seen by Digia business units and HR is to focus on objective two which was to find out and plan for the next development activities of the Technology Management process. In the second spiral of the action research of this thesis

will focus only on the plan phase as doing the actual next development activities (act & observe) are out of scope regarding this thesis.

5.2 Plan to update the Technology Management process

The plan to update the Technology Management process in CPM is based on the Process Improvement process which is also defined in the CPM. The Process Improvement process is meant for continuous organizational learning and development. Its purpose is to further develop the competitiveness of company processes, and practices for ensuring the effectiveness and efficiency of Digia operations (Digia CPM. 2020). This plan is Kemmis and McTaggart's action research spirals first step.

The need for updating the Technology Management process has been heard in multiple internal discussions held at Digia. The Technology Management process was seen by internal stakeholders as a non-realistic representation of technology management subprocesses and activities in Digia and there was little to no governance of technology management. Also, there were some development ideas brought up which needed validation and a plan to implement those ideas. These development ideas were validated during the writing of this thesis and the output is described in the topic 6.1 Development ideas.

Juhana Juppo, Digia's Chief Technology Officer (CTO) has been acting as the stakeholder to this thesis and is also introduced in the topic 4.4 Stakeholders. A plan was created to reach the objectives of this thesis. The plan required and included splitting tasks that would fit the requirements or characteristics of specific, measurable, attainable, relevant, and time-based criteria. In practice this meant that the task could be done in a week so the work in progress would not be accumulated and tasks would get done.

The plan for these development activities was initiated by the release of Digia's new strategy and the need to synchronize the Technology Management process to fit the new strategy. Juhana Juppo was consulted on the initial plan to update the Technology Management process and the plan to gather all relevant data to validate the to-be-developed ideas was laid out which is described under the next topic.

With the already attained knowledge, insight, and understanding of the thesis context the plan had a total time of 16 weeks as described in the below figure.

	Weeks	NOW															
Activities	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Initial plan for the Thesis with Juhana Juppo	x																
Thesis Project Plan draft in Word		x															
Gantt Chart for project plan		x															
Write: Digia strategy 2020-2022			x														
Write: Digia CPM			x														
Write: Digia Tech radar			x														
Research: Technology management frameworks				x													
Write: Technology frameworks				x													
Research: Technology Management process updates					x												
Write: Update process of the Technology Management proces					x												
Write: Release notes and Digia internal news updates					x												
Update Technology Management process in CPM						x											
Research: Questionnairs for Digia business units and HR about the Technology Management process							x	x									
Meetings with Digia business units and HR									x	x							
Write: Reflections of the updates to the Technology Management process										x	x						
Research: Technology management frameworks											x	x					
Research: Plan to further develop Technology Management process											x	x					
Write: Plan the next development activities of the Technology Management process												x	x				
Review and iterate the plan for the Technology Management process update													x				
Write: Summary														x			
Write: Conclusions and suggestions														x			
Send the thesis for comments														x			
Review and iterate the comments															x		
Send the thesis for approval																x	

Figure 12. Original work plan (Gantt) on 28.03.2020.

5.3 Collecting and analysing data

There were multiple data sources gathered for this thesis. Research material was gathered to support the writing of this thesis and data gathered through the Technology Management processes Technology Management Governance subprocess.

5.3.1 Research material

All research material that was collected to help the update process of the Technology Management process and writing process of this thesis is stated under the topic 8 Bibliography. The most foundational research material was Gregory's paper on Technology management: a process approach that acted as a basis of this thesis and the update of the Technology Management process in Digia (Gregory, 1995). The research material on technology and service lifecycle acted as supporting material to create a holistic perspective on how technology management activities are related to lifecycle frameworks.

5.3.2 Technology Management Governance data collection

Technology Management Governance creates a management framework around governing the technology lifecycles in Digia. During the H1 of 2020 the technology management

meetings enabled the efficient and structured way of collecting data to support writing this thesis.

Digia Technology Management Process 2020 H1 Questionnaire

The Kemmis and McTaggart's action research second step Act & Observe started by creating a questionnaire. The questionnaires were sent out to Digia's business unit directors and managers to get qualitative and quantitative data to support and plan out the update activities of the Technology Management process.

The questionnaire included questions about the fit of Technology Management process to Digia, key objectives on how to better fit the Technology Management to Digia's new strategy, the usefulness of Digia Tech Radar to HR, Recruiting, Sales, Development and Operating of IT Services, key objectives on how Digia Tech Radar should be developed to fit the Digia's new strategy and finally on what to consider before updating the Technology Management process in Digia (appendix 1 Digia Technology Management Process 2020 H1 Questionnaire).

During the Technology Management H1/2020 meetings with Digia business units there were multiple data sets attained. This meeting is a part of the Technology Management processes Technology Governance subprocess. These meetings were held during weeks 20-21 according to the plan described in the previous topic.

All Digia business units who were participating in the meetings were required to fill out two spreadsheets as a prerequisite to the meeting. One of the spreadsheets was related to the given business unit's technology stack and the business units' technical leaders updated the data set based on the previous Technology Management meeting in quarter 4 of 2019. The second spreadsheet was related to strengths, weaknesses, opportunities, and threats (SWOT) related to technologies and the Technology Management process as seen in the below figure.

Who filled it:	N.N.
DA/DG/BU:	e.g. Analytics
Date:	1.5.2020
Instructions	
Fill in this SWOT from yours DG's technology management perspective.	
Strengths	**Weaknesses**
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.
Opportunities	**Threats**
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

Figure 13. Technology Management meetings SWOT spreadsheet sent out to Digia business units during H1/2020.

5.4 Reflecting on the update process

Data gathered during the Act & Observe phase in the action research spiral process were analyzed in the Reflect phase to plan out the next development steps of the Technology Management process. During the Reflect phase all the data gathered was summarized and used as a basis to come up with the revised plan. The revised plan output can be found in topic 6 Results.

6 Results

During the 2020 H1 while doing this thesis there were multiple meetings with various internal Digia stakeholders. During the meetings with internal Digia stakeholders in 2020 H1 about Digia Technology Management process we made requests about the development ideas on how to improve the Technology Management process (appendix 1 Digia Technology Management Process 2020 H1 Questionnaire). There were also some development ideas found earlier in meetings with Digia HR and CTO Office. The development ideas are described below as well as the final plan on how to approach the development of the Technology Management process. All development ideas are described under their respective topic with the description, feasibility, and business value of each development idea.

Therefore results, development ideas, and plans to further develop the Technology Management in Digia are part of "3. Reflect" and "4. Revised Plan" phases in the Kemmis and McTaggart's action research spiral.

6.1 Development ideas

6.1.1 Digia Internal Digia Tech Radar

Description

Currently, the Digia Tech Radar is open to the public. There have been discussions and evaluations of the public availability of the Digia Tech Radar but it has been evaluated that with the current aggregated data set it does not include any corporate confidential or privacy-related data so it can remain available to the public.

There have been discussions on further developing the Digia Tech Radar to better serve the needs of Digia internally. This means more detailed data sets which in part are described in the following development ideas on Digia Tech Radar.

Feasibility

Currently Digia Tech Radar is hosted in Amazon Web Services (AWS). The master data for Digia Tech Radar is stored in a secure location and the same data set could be expanded to have more internal information. The production environment could be duplicated in a way that one production environment would be open to the public and the other production environment open to Digia internal, but the security perspective needs to be further analyzed.

Business value

Digia Internal Tech Radar could help at least Digia's recruiting, sales, and continuous services by providing further in-depth details about the technologies in use in Digia. The next paragraph describes more closely the in-depth details the Digia Tech Radar could offer.

6.1.2 Digia Tech Radar with more detailed information

Description

All technologies have currently the following information published:

- Quadrant
- Ring
- Name
- Link to Google search
- Link to Google Trends search

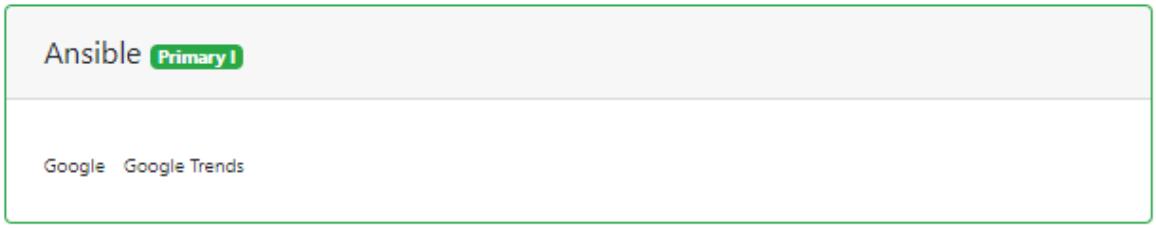

Figure 14. Current information box about one technology.

The current visualized box for all individual technologies makes it easily possible to further increase the information about a certain technology. Some aspects that have been considered but not yet implemented are:

- Description of how the technology is used in Digia
- Technology champion for an individual technology
- Contact persons for the technology in business units

That more detailed information is not feasible for every technology in Digia Tech Radar since there are a total of 176 identified technologies currently in Digia Tech Radar. It should be considered that technologies in rings Primary I and maybe Primary II could include more detailed information. It is important to not just consider the creation of more detailed information but also the effort needed to keep the information up to date.

During the technology management meetings with Digia internal stakeholders there was also other information gathered from all technologies in use, as seen in the figure below.

Topic	**Scale**					
Usage	High (>75%)	Medium (35-75%)	Small (<35%)	Not at all (0%)		
Trend	Increasing	Decreasing	New	Potential		
Recruiting needs	High	Medium	Low	No needs	No idea	N/A
Ring	Primary I	Primary II	Trial	Hold		
Category	DevOps & Tools	Programming Languages, Frameworks & DB	Products, Platforms & Cloud	Integration & API		

Figure 15. Technology data gathered from internal Digia stakeholders.

Usage, Trend, and Recruiting needs are used to better understand the different kinds of usage patterns throughout Digia and make more educated and holistic decisions on which Ring should the given technology belong in Digia Tech Radar with the corporate-level aggregated results. When comparing results from different Digia internal stakeholders there were differences in the evaluation of a given technology as some stakeholders might consider technology in the ring “Trial” and another one in the ring “Primary I”. Also, open feedback on comments for trend, contact person, and description of usage was gathered. The additional data gathered makes it easier to analyze and decide on which ring the given technology belongs to.

The data provided is also being currently used internally for evaluating certain technology trends that might need some corporate-level governance for example in recruiting or knowledge development. This entire data set could also be made publicly available through Digia Tech Radar.

Feasibility

All these in-depth details about technologies are feasible to develop. Description contains multiple development ideas and some of this data could be already be published through Digia Tech Radar. Consideration should be taken to properly evaluate which data should be made only available in Digia internally as it might include corporate confidential data. The user experience related needs of Digia Tech Radar should be also be considered as more information can clutter the user experience and make it less readable and hence usable.

Business value

More detailed information about individual technology in Digia Tech Radar would help our technology experts, HR, and sales. Technology experts could to better evaluate the feasibility of a given technology to their needs and find out support internally within Digia to better understand the capabilities of a given technology. HR could use Digia Tech Radar to evaluate the need of developing individual technologies within Digia or evaluate needs and capabilities in recruiting. With the data provided, sales would be able to better understand the usage of technologies and reach out internally to have technology experts help with pre-sales and sales processes.

6.1.3 Digia Tech Radar with alternative views

Description

Digia Tech Radar's ability to filter technologies based on:

- Business Unit
- Delivery Group
- Program or Project
- Strategic focus points

Feasibility

Technically the Digia Tech Radar already provides a filter functionality as it is possible to select individual quadrants or rings for more detailed viewing. This functionality could be made to filter out the data with the filter options described. The need for quadrant or ring filters needs to be estimated as they could be replaced with these proposed filters. These views should be made only available in Digia internally as it might include corporate confidential data.

Business value

With these filter options individuals within Digia could more easily and autonomously find out where certain technologies are used and could reach out to find help. I feel that providing these functionalities to support autonomous usage of Digia Tech Radar would mean positioning it as a go-to tool for learning about different technologies used in Digia.

6.1.4 Ability to update the Digia Tech Radar without the help of CTO Office

Description

Currently all the updates to Digia Tech Radar are done with the help of the CTO Office. Data or input for the need for the update is gathered through the Technology Management Governance subprocess or Digia Tech Radar Suggest an update form.

All Digia organization units could have a technology lead who could be responsible for updating their business units, delivery groups, programs, or projects tech radar.

Feasibility

Currently, the master data is not in a very sophisticated format in terms of updates which should not be the case. Improving this should require that the data would be stored in a database where the data could be more easily updated through a form or control panel. Currently, the access management is managed through individual user rights with master data access but in this scenario, it would be obligatory to have access management which would allow particular people to update only their data.

Business value

Making every Digia internal stakeholder more involved with the Digia Tech Radar and let them autonomously update their own organization unit's tech radar might make the Digia Tech Radar feel more the tool of their own. This change could also enable the individuals to update and enrich the data which could help Digia as a company immensely as currently the data is gathered only through the Technology Management Governance model.

6.1.5 Technology Roadmap template

Description

Technology Roadmap contains solutions to (at least) following items:

- Define the desired level of capability and how this level is reached (training, internal transfers, recruiting) and when it is reached.
- How technologies are tested and proven to work before more widespread usage in projects and services. This could be and is currently achieved through Proof of Concept (PoC), Riskiest Assumption Tests (RAT), or pilot phases which provides insight on whether the technology is feasible or not for the attended usage.
- Define how this technology is deployed into the organization's knowledge base. This means training and orientation to everyone in the organization that needs to have an understanding of what this technology is and what it brings to the organization. This includes at least minimum sales, marketing, communications, delivery managers, architects, and developers.

Feasibility

Technology roadmaps are currently done by Digia's individual organizational units excluding Digia's strategic focus points which are handled in Digia level. If technology roadmaps would be a more integral part of the Technology Management process and particularly part of the Technology Selection subprocess in Digia it would bring more quality to the technology evaluation and later mitigate the risks of selecting the technologies for Digia exploitation. At a minimum this could be a checklist of things to do, consider, or plan in the technology roadmap.

Business value

There are many successful PoC's and pilots executed internally in Digia to evaluate different technologies. Success in this context means that the wrong technologies have been

evaluated but not selected for further exploitation and the right technologies are selected for further exploitation with the business value produced through projects and services. There are many ways of performing the above mentioned and there could be scaled, and productive results gained if the practices would be similar between organizational units. One part of the possible checklists could cover the communication part which would enable cross-Digia communication regarding individual technology evaluation which could mean a decrease in duplicate work on any given technology evaluated accidentally by multiple organization units.

6.1.6 Retirement plan template for technologies

Description

All technologies are reaching their end of life stage at some point. The retirement of technologies is a normal part of the business. Retirement decision is usually a business decision the plan for the retirement is done usually by technically oriented experts. The retirement plan template for technologies would help the creation of a retirement plan for technologies with clear guidelines and checklists on what to consider during the retirement phase of technology.

Feasibility

Creating a template for this which would be an easy task. There is a lot of expertise in Digia which could be used to harness the knowledge through a workshop that would focus strictly on the creation of a retirement plan for technologies. Digia Tribes could be used as a place for finding the right people to get involved.

Business value

Any changes to technologies regarding a service always costs money as there are resourcing involved with Digia employees. Any time saved on the retirement would save money for Digia and our customers. Also making sure all the necessary things are considered, planned, and acted on with the help of retirement plan template would mitigate any risks involved with poor planning of retirement of a technology.

6.2 The development plan for the Technology Management process

All development ideas listed above are feasible to implement. Those could be developed in a step by step approach in the order as presented in the previous topics. It's been estimated that each development idea would take around one month to develop from end to end meaning from idea to production. the development would start from publishing a Digia internal Digia Tech Radar which acts as a prerequisite for further development activities excluding the technology roadmap and retirement plan templates. The Development plan is described in the below figure.

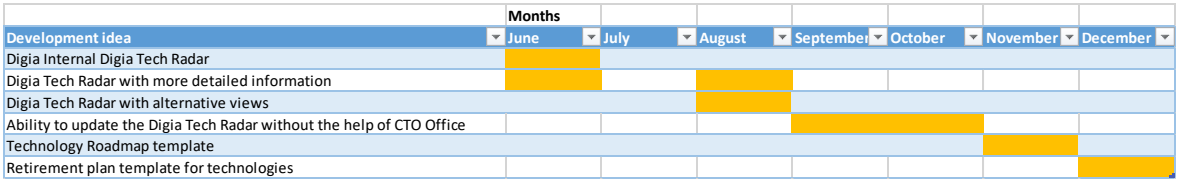

Figure 16. Gantt chart for the Technology Management development ideas for 2020.

The development of these ideas is the responsibility of the Technology Management process owner and the CTO Office will support the development activities.

6.3 Risks related to the development of the Technology Management process

There were three key risks identified involving the development of Technology Management in Digia: 1. implementation of technology management activities in individual organizational units, 2. no time to develop the technology management development ideas, and 3. changes in organizations' individual key experts.

The risks were evaluated based on three impact categories and their sum and with probability as seen in the figure below.

	Cost or work impact (0-10)	Timetable impact (0-10)	Business impact (0-10)	Sum (0-30)	Impact in scale of 1-5	Probability (0-5)
1. Implementation of technology management activities in individual organizational units	3	5	8	16	2,666666667	2
2. No time to develop the technology management development ideas	0	10	6	16	2,666666667	3
3. Changes in organizations individual key experts.	6	8	7	21	3,5	2

Figure 17. Risk evaluation of development ideas of Technology Management in Digia.

In impact analysis the scale from 0-10 per area cost or work impact, timetable impact, and business impact are from 0 being the least amount of impact and 10 being most impact. I then summarized the impact results and put them on the scale from 1 to 5. Probability was evaluated with the scale from 0-5 in which 0 is unspecified and 5 being very likely. The impact scale 1 to 5 and probability scale 0-5 is the scale that is used in the risk summary described later in this chapter.

1. Implementation of technology management activities in individual organizational units

It is not feasible to try to achieve a goal where all technology management related activities would be similar all over Digia. Many of the organizational units have their special needs and operation environments with varying restrictions and possibilities. This means that technology management activities vary also from organizational units to another. In case technology management activities are not implemented in different organizational units, the impact is mostly related to business impact. The results and value derived from the successful execution of the Technology Management process and its activities cannot be achieved. The likelihood of a business impact for example poor decisions on technologies for exploitation will result in lost revenue and profits.

The probability is unlikely (2) as the foundation for technology management in Digia has already been laid out so the implementation should go smoothly as planned.

2. No time to develop Technology Management process development ideas

As the Process Owner is not the only role which I have in Digia, there is always the time restraints on how much time there is to spend on the development activities. And as I need the support from CTO Office team and possibly other stakeholders in Digia their time usage is also a concern. The most impactful thing this risk has is the timetable impact as development activities might be postponed due to other more important customer or internal projects. The probability of this risk to actualize is moderate (3) as especially me as a process owner and the rest of the CTO Office team are working in highly demanding projects and priority of those activities is higher than developing the technology management further.

3. Changes in organizations individual key experts

Employee retention within CTO Office has been at a good level for the past two years and as they are the key experts in developing these ideas further the probability of the risk is unlikely. If there would be any changes in the organization's key experts the impact of this risk would be moderate. The impact is mostly focused on work impact as any changes to key experts resulting in the need of transferring knowledge and know-how about the Technology Management process and its development activities. To mitigate this risk all, the development ideas and the Technology Management process is documented thoroughly to help the possible changes to key experts.

Summary of risks

All three key risks identified and described above are not that high on risk scale as summarized in the below figure.

		Probability					
		Unspecified	Very unlikely	Unlikely	Moderate	Likely	Very likely
Impact	Critical						
	Major						
	Moderate			3.			
	Minor			1.	2.		
	Trivial						

Figure 18. Summary of risks involved in Technology Management in Digia.

With the mitigation plans in place there are no major risks and the development of Technology Management in Digia will continue as planned.

6.4 Summarising findings

Technology management has been in a good and mature state in Digia before. With the recent development activities described in this thesis, the development ideas, and the planned activities I feel strongly that the Technology Management process in Digia can and will play a bigger role in Digia in the future.

7 Conclusions and suggestions for further studies

Gregory described the Technology Management process approach in 1995 (Gregory, 1995). Even though the world has changed a lot during the past decade I feel that the Gregory framework still works as a good foundation for technology management the framework being in existence for 25 years already. The most important thing, as with any framework, is to tailor the framework to your environment and implement other relevant frameworks to the same context as I have described with the Technology Management frameworks relationship the different technology and service lifecycles.

The Technology Management process in Digia has already seen many minor and major updates in recent years. It is important what and how is described in the CPM as the process's definition, activities, roles, responsibilities, inputs, and outputs. With good quality documentation of a process the stakeholders involved with the process can execute the process successfully. The stakeholders involved in the process should be heard out continuously and figure out if any improvement ideas or concerns should be taken into consideration and develop the process further.

New technologies are popping up in the market constantly and the pace of change is quite fast. Managing these new technologies cannot solely rely on the current processes and the management of these new technologies might point out weaknesses and short fallings of the current process.

The key to success is continuous improvement and understanding that new frameworks and guidelines are constantly developed all over the world and there might be lessons to be learned on how to improve the process and enable the successful execution of the process.

It is crucial to follow up on the market trends hype cycles of new technologies and management frameworks that could deliver more business value for Digia and enable Digia to reach its strategic and business goals.

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Appendices

Appendix 1: Digia Technology Management Process 2020 H1 Questionnaire (CORPORATE CONFIDENTIAL)